Solvent Standardization Project: Weapons Cleaning Using Breakthrough and the IT48WC Parts Washer (#176)

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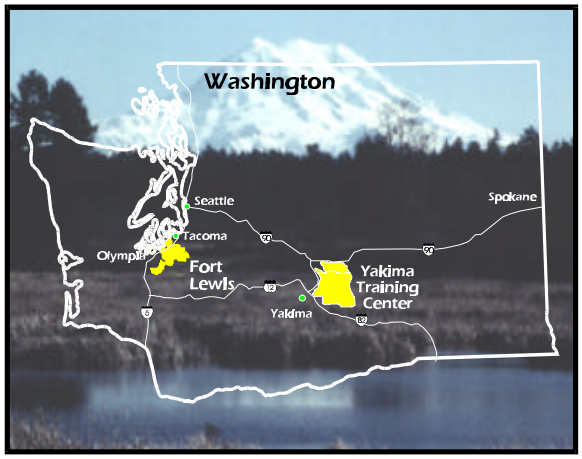

"The mission of Fort Lewis is "to train, mobilize, and deploy combat ready forces to fight and win worldwide; to care for soldiers, families, and our workforce; and to sustain a quality installation."

IDENTIFICATION

Fort Lewis Military Reservation is an 86,176 acre Army installation located 35 miles south of Seattle and 7 miles northeast of Olympia. Various military and non-military organizations at Fort Lewis perform services and functions that require the use of hazardous substances and generate hazardous waste. These activities are vital to the field readiness of military troops and support the day-to-day functions of Fort Lewis as a community. Services include the maintenance of over 4,500 Fort Lewis buildings and infrastructure such as roads and utilities, operation and maintenance of over 3,000 vehicles and nearly 1,500 pieces of equipment including aircraft, weapons systems, power generators, and communications equipment. A major hospital, several medical and dental clinics, printing and graphics facilities, materials storage warehouses and crafts shops also operate on Fort Lewis.

Fort Lewis, the largest employer in Pierce County, has a combined military, civilian and retiree payroll of almost $1 billion. Fort Lewis' force structure includes I Corps Headquarters, which commands all Forces Command units at Fort Lewis. I Corps Headquarters conducts planning and also acts as a liaison with other active and reserve component units in the continental United States and active duty units located around the Pacific Rim and in Hawaii. Fort Lewis directly supports the Yakima Training Center and six Base Realignment and Closure installations in Washington and California. The installation also serves occasional users from other U.S. armed services and units from allied nations.

PROGRAM OVERVIEW

The solvent standardization program is a major pollution prevention initiative designed to reduce the different types of solvent waste currently generated at Fort Lewis. This project reduces regulatory management and reporting burdens placed on the soldier by reducing the number of solvents authorized for use. In addition, the regulatory reporting burdens for the Hazardous Waste Program, Pollution Prevention Program and the EPCRA Program are reduced.

This program was designed to target vehicle maintenance applications and weapons cleaning. The Safety Kleen contract is the preferred solvent source for parts cleaning in vehicle maintenance. Service schedules have been increased from 2-week cycles to 8 or 12 week cycles and all parts washers have filters. Implementation of this project resulted in a 64% reduction in waste generated from Safety Kleen solvent.

The weapons cleaning standardization project was driven from a health and safety aspect rather than from a waste reduction aspect. Cleaning weapons generated various waste streams that were being mismanaged. Various materials have historically been used to aid in the removal of carbon from weapons. These materials included, but were not limited to mixtures of diesel and pine oil, trichloroethylene and gasoline, oven cleaners, carbon removing compounds, and breakfree. The purpose of the weapons cleaning standardization project was to provide the tools and a standard solvent to aid in weapons cleaning.

TECHNIQUES AND INNOVATIONS

Prior to reassembly and storage, weapons require periodic cleaning to remove dirt, dirty lubricants, and carbon. A variety of materials had been used to clean weapons at Fort Lewis. The materials were often sprayed on and wiped off. This process was then repeated at least three times over a period of three days. Many of these materials were hazardous or contained ozone depleting substances. The absence of dedicated cleaning stations and the absence of spent weapons cleaner as a waste stream lead the environmental staff to fear that these hazardous materials may have been mismanaged or disposed of improperly.

To reduce the probability of improper waste disposal, reduce the amount of time required to clean weapons, reduce solvent use, and to identify a standardized, less regulated weapons cleaning solvent, a field demonstration was initiated. The Mobility Technology Center-Belvoir, Fuels and Lubricants Division, is the DOD Executive Agent for all Ground Fuels and lubricants and also manages the P-D-680 federal specifications. The field testing at Fort Lewis began in May 1996 and was a joint venture with Fort Belvoir, I Corps Science Advisor and Public Works Environmental and Natural Resources Division. Fort Lewis was the DOD field test site for Vehicle Maintenance and Small Arms Operations. The field tests assessed the performance and toxicity of eight candidate solvents used to clean weapons and vehicles. Solvent cleaning power, compatibility, drying time, corrosivity, the propensity to leave a residue, odor, and dermal toxicity were all rated for each of these eight candidate solvents, as well as for the current P-D-680 type I-II and type(III) solvents. To facilitate this evaluation, several tanks were purchased.

Between October, 1996 and March, 1997, the Fort Lewis Public Works - Environmental and Natural Resources Division (PW/ENRD) purchased, installed, and retained custody of 37 "IT-48WC" weapons cleaning stations from "Inland Technology". Thirty-two of these weapons cleaning stations were installed at Fort Lewis and five were installed at the Yakima Training Center. The IT-48WC station was selected because it was the only station that was designed for weapons cleaning at that time. However, we have identified significant design flaws.

In October of 1996 the tests concluded that "Breakthrough" was the best candidate and that it would be implemented as a pre-cleaning step in all weapons cleaning functions. Breakthrough (NSN #6850-01-378-066) consists of C-12 and C-13 paraffinic hydrocarbons (CAS # 54742-48-9). It is

relatively odorless and has a low dermal toxicity. It has a flash point of 150û F, a vapor pressure of less than 2 mm Hg, and is 100 percent volatile.

The IT-48WC is designed so that two individuals can clean weapons simultaneously. It measures 48 inches wide and 28 inches from front to back. It is designed so that solvent from the bottom of the 55-gallon tank is pumped by a 15 gallons per minute (GPM) pump through a stainless steel filter and then through a 0.01 micron filter. (The actual flow rate appears to be significantly less than 15 GPM.) After traveling through the filters the solvent passes through an 18 inch flex hose or through two clear lines and through two brushes (in parallel). The brushes are used to clean weapons. The dirty solvent is collected in a work tray before it runs through a 3.5-inch drain basket (which is designed to capture large debris) and is then recirculated through the system again.

During the summer of 1997, PW/ENRD, which has custody of the weapons cleaning stations, became concerned about the frequency with which the secondary filter needed to be changed. This is because the pre filter's porosity was too great for it to effectively remove any contaminants. The metal pre filter wouldn't capture any contaminants until it got clogged up and had to be taken out and wiped with a pad creating an extra waste stream. Subsequently all the contaminants were caught in the main filter. Changing filters takes about fifteen minutes per tank. It is also costly. Initially, the main filters cost $18 each. (They now cost $8.87.) Furthermore, if the filters clog and the pump is allowed to continue to run, the pump will burn out and require replacement. To increase the life of the main filter, the prefilter (a stainless steel screen) was first replaced with a 20-micron cotton filter to increase the effectiveness of the initial filtering process. This resulted in the pre filter becoming clogged very quickly necessitating frequent changes. The 20-micron cotton filter was therefore an unacceptable alternative. A resin filter (NSN #4250-01-381-8036) which ranged from 50 microns on the outside to 10 microns on the inside was then tested and found to be an acceptable replacement pre filter. We implemented these pre filters in all our weapons cleaning stations and now we get twice the life out of our main filters. These new pre filters cost $4.08 each.

To reduce the frequency of solvent replacement, PW/ENRD began testing on-site filtration (in addition to the two filters on each weapon cleaning station). On-site filtration consists of an outside vendor coming on-site to the tank itself, removing the solvent from the tank, cleaning the tank, changing the filters, filtering the solvent making three to six passes through their mobile filtration system and putting the solvent back into the tank. The tests were successful and PW/ENRD has incorporated this service into its standard operating procedure. This new filtering frequency is unknown and is contingent upon the contamination rate of the solvent (which is in turn dictated by the cleanliness of the part), but it is estimated that filtering is required about once every six months.

POLLUTION PREVENTION PROJECT BENEFITS

This project significantly reduces the probability of improper hazardous waste management and improper hazardous waste disposal. In the past, weapons were cleaned in a variety of locations, some of which were unknown. These dedicated cleaning stations ensure that solvents used for weapons cleaning are managed or disposed of properly. This project has also focused attention on proper waste management of solvent contaminated absorbent pads, rags, and other debris, and has significantly reduced the probability that this type of hazardous waste will be disposed of as non-hazardous waste.

This project also reduces the toxicity and environmental impact of solvents used and establishes a uniform solvent for weapons cleaning. Many of the weapons cleaning solvents contained substances that deplete upper atmospheric ozone and have been banned from production under the Montreal Protocol. Breakthrough does not contain any ozone depleting substances and is significantly less toxic than many of the weapons cleaning solvents previously used. Furthermore, the new solvent and weapons

cleaning stations reduce the amount of time required to clean weapons by approximately 85 percent. This in turn has very large economic benefits.

Hazardous Waste Reductions: It is not possible to accurately calculate the hazardous waste reduction that results from this project. Much of the waste that was generated from weapons cleaning in the past was mismanaged (e.g., disposed of as non-hazardous solid waste). Therefore, there is no baseline data (i.e., we do not know how much hazardous waste was actually generated from weapons cleaning prior to the implementation of this project). Since we do not know how much hazardous waste was generated in the past, we cannot quantify the waste reduction. Through pollution prevention, this project served to improve compliance (by improving waste management).

Hazardous Material Use Reduction: The amount of hazardous material reduced as a result of this project is estimated at approximately 4,000 gallons per year. Breakthrough is the approved solvent for pre-cleaning the weapon prior to final detail. By providing an odor-less solvent in a large format parts washer, we reduce the frequency of exotic cleaners being used for removing carbon.

Economic Benefit: Because of the reductions in troop labor (85% reduction), this project had a payback period of 15 days. This project saves Fort Lewis almost $2.9 million per year (based on a project life of 10 years), and has a ten year net present worth of over $22 million. Implementation of this P2 project is therefore justified, and the cost savings are validated on an annual basis.

Life Cycle Analysis of Risk Shifting: This project reduces the toxicity of solvent used, reduces the probability that solvents will contaminate soil and surface waters, and reduces ozone depleting substance emissions. Furthermore, risk is not shifted from one process, product, or environmental medium to another. Therefore, there is a net reduction in risk to the environment.

LESSONS LEARNED

Fort Lewis has been very happy with Breakthrough, the new solvent that was implemented. At the time of implementation, these weapons cleaning stations were the only ones available in a large format. . However, the weapons cleaning stations have not been without problems. These problems include the following.

- The lids have a fusible link for fire protection. These links must be released prior to shutting the lid. Invariably, personnel attempt to shut the lid without releasing it. This causes the lids to bend and buckle. Eventually, the rivets attaching hinges to the lid loosen until hinges become inoperable. The hinges should be manufactured with bolted hinges instead of riveted hinges.

- The lids do not have a handle on them and they are difficult to open. The lids should be manufactured with handles.

- The filtering system in the cleaning station suffers from significant design flaws. The system consists of two filters in series. The filters are designed to clean the solvent and prolong its life. The first is a stainless steal mesh with a porosity that is too large to capture most of the contaminants. The second filter is a 0.01-micron filter that becomes clogged very easily. If a filter is not changed when it is plugged, the pump will burn out and require replacement. To reduce labor and costs associated with secondary filter replacement, the first filter has been changed from the stainless steel mesh to a resin filter that ranges from 50 microns on the outside to 10 microns on the inside (NSN #4250-01-381-8036).

- To prolong solvent life, Fort Lewis has begun to use an outside contractor to come on-site, remove the solvent from the tank, clean the tank, change the filters, filter the solvent on-site, and

then put the solvent back into the tank. The frequency of this on-site filtering is expected to be once every six months.

- Too much solvent in the IT-48WC tank. There is less than one quart of solvent inside the filter canisters. There is also less than one quart of solvent actively being used on the surface of the parts being cleaned inside the tank. It is fair to say that the total volume of the active solvent is less than one half gallon. The 55-gallon solvent reserve in the IT-48WC is 100 times the volume of the active in-use solvent. We believe that the larger sink format of the IT-48 does not justify the huge increase in the size of the solvent reserve.

- To reduce the probability of solvent contamination, locks have been installed on weapons cleaning stations.

CONCLUSION

Breakthrough provides an odor free pre-cleaning step for weapons maintenance. The IT48WC provides a tool to clean the weapons safely and efficiently. The major cost savings from this project is due to reduction in troop labor.

Under the Pollution Prevention Act of 1990 and Washington State Waste Reduction Act (WAC 173-307) users of hazardous substances and generators of hazardous wastes are required to set goals to reduce usage of hazardous materials and generation of hazardous wastes. This pollution prevention initiative is a source reduction initiative (technology change, procedural change, and a product change). Breakthrough is a product substitute that is less toxic and less hazardous. The parts washers with the filtration system extend the life of the solvent thereby reducing the volume of product purchased and the volume of hazardous waste generated. A follow on pollution prevention initiative, the changing of the metal mesh filter to a resin filter reduces the volume of secondary filters used. Implementing the on-site filtration program extends the life of the solvent and reduces labor associated with management of the parts washer.